

Research Note

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Wood Performance in Doorways of Single-Family Houses

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SUMMARY

Front doors and door frames in 175 new houses with slab-on-ground foundations were examined for moisture and decay problems in three Mississippi counties that border the Gulf of Mexico during summer 1973. Defects were often the result of building techniques of particular developers. No special problem was detected that would cause frames or doors to have excessively high moisture contents. The lengths of roof overhang in front of the doorway generally did not significantly affect the moisture content of wood at the base of either the door or the door casing.

INTRODUCTION

Since wood is the most commonly used material in exterior doorways of homes, it is important to determine construction factors that will extend the service life of the doorways. Most of all, techniques that minimize moisture content in the wood should be used.

METHODS

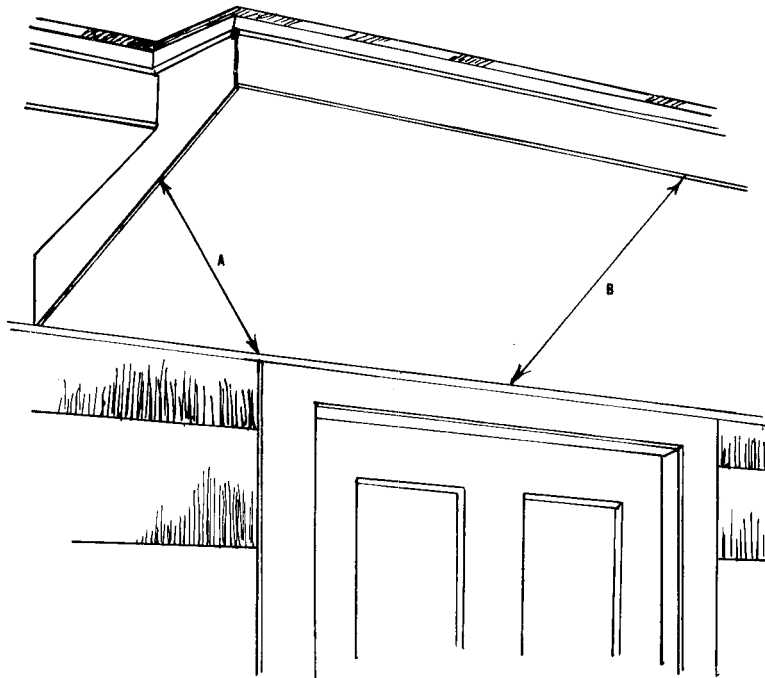
Front doors and door frames of 175 houses were examined in the three Mississippi counties that border the Gulf of Mexico (Hancock, Harrison, and Jackson Counties). Most of the houses were built between 1968 and 1972 (some before 1960) under the U.S. Department of Housing and Urban Development's (HUD) program that is commonly referred to as "235." All were managed by either the USDA Farmer's Home Administration (FmHA) or by

HUD. Houses were randomly selected from HUD and FmHA lists and were visited in order of their selection during summer 1973.

For each doorway the type of door (panel or flush) was recorded. Panel doors consist of filler panels of wood framed by stiles (solid vertical members) and rails (solid cross members). The upper panels may be of glass. Flush doors consist of thin plywood faces applied to a framework of wood with a wood block or particle board core (Anderson 1970). In exterior applications flush doors should be of the solid-core type. The distance to the edge of the roof directly in front of the door was measured, and the distance to the edge of the roof nearest the front door was measured (fig. 1). The direction perpendicular to the front door when closed was determined with a compass. Moisture content at the (A) top of the exterior casing, (B) exterior base of the jamb, (C) exterior bottom of the door itself, and (D) base of the interior casing, was measured to the nearest percent with a Delmhorst moisture meter (fig. 2). We also noted the condition of the wood: presence of splitting veneer, fungal discoloration, or decay detectable by probing with a knife. The presence or absence of weatherstripping between door and frame and condition of sealants about the exterior frame were recorded.

Doors were divided into four groups by direction faced. An analysis of covariance, with distance to the edge of the overhang as covariate, was made to determine if the directions doors faced affected their moisture content. Moisture contents at the locations around the door were regressed against the distance

Figure 1.—Measurement of overhang at doorways: A, Overhang distance to nearest edge from doorway; B, Overhang distance to edge directly in front of the doorway. In some instances A and B are the same.



to the edge of the roof in front of the door and against the minimum distance to the edge of the overhang for each group of doors and all doors combined. A second degree polynomial was suggested by the assumption that at some point increasing the overhang offers no additional protection.

One hundred fifty-five of the houses were in subdivisions where the developers could be identified. The nine developers were labeled A through I, and their houses were then grouped and compared for frequency of defects in the front doorways.

RESULTS

More than anything else, defects in doors and frames were related to developer ($\alpha .0004$). Two developers for which a total of 39 houses were examined had front doorways entirely free of defects (table 1).

The average distance to the edge of the roof directly before the doorways was 57 inches. The average minimum distance to edge of roof overhang above the doorways was 49 inches. Regression analyses of the relationships between distance to edge of roof overhang and wood moisture content never explained more than 5 percent of the variation in observed wood moisture contents.

We could not determine the quality of flush doors nor whether the frames or doors had been treated with a preservative. Informal contacts with building suppliers in the three counties suggested that preservative-treated frames were seldom used in these houses.

Frames

The average wood moisture content of the frames was 11 percent (Standard deviation = 1.84) at the top of the exterior casing, 13 percent (sd. = 6.04) at the

Table 1.—Percent of houses with a defect in doorway.

Developer	A	B	C	D	E	F	G	H	I
No. houses examined	24	39	15	12	9	10	13	17	16
Percent of houses with defect	0	5	0	17	56	10	8	12	25

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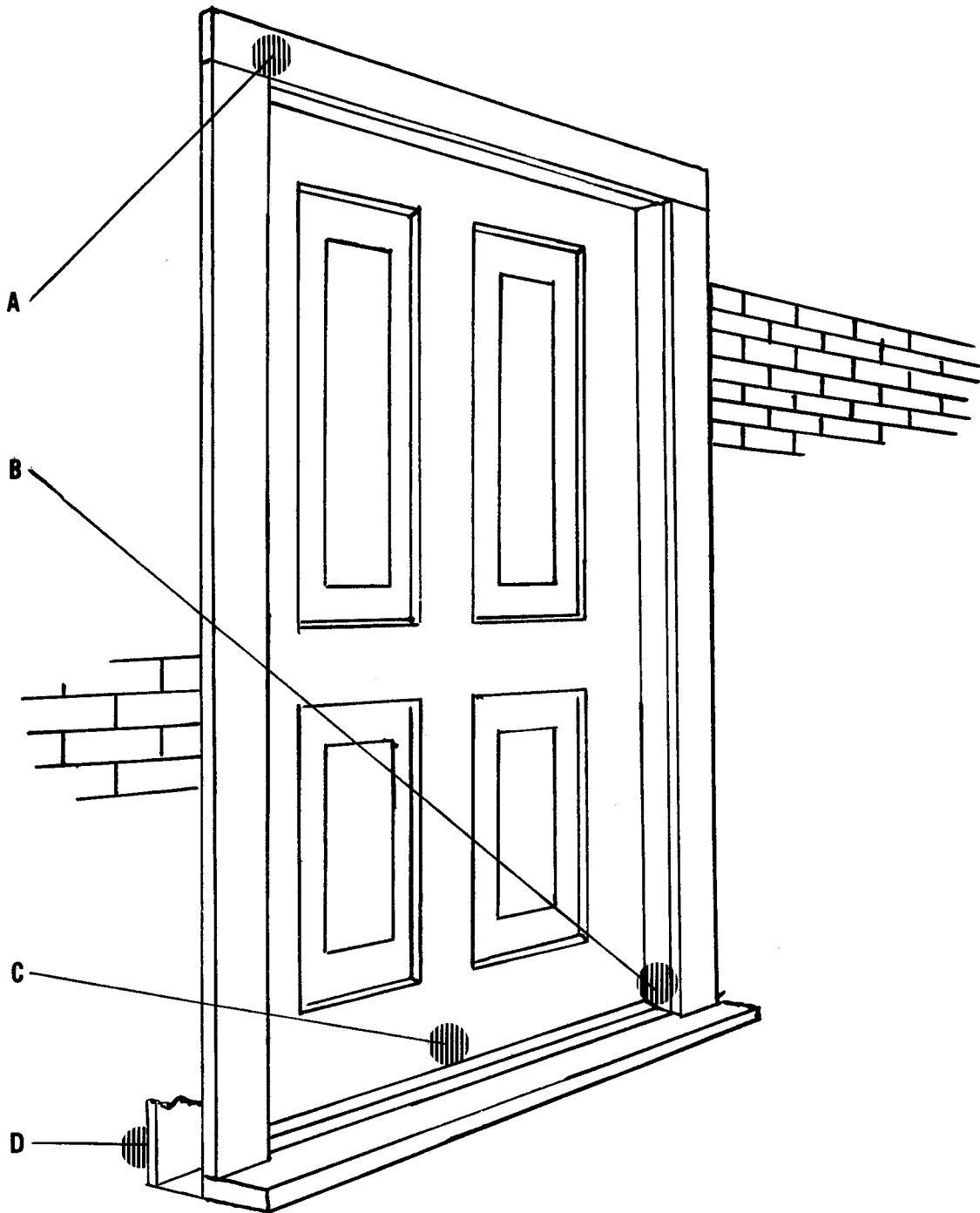


Figure 2.—Moisture content measurements in doorway area; A, Top of the exterior casing; B, Exterior base of the jamb; C, Exterior bottom of the door; D, Base of the interior casing.

exterior base of the jamb, and 15 percent (sd. = 7.58) at the base of the interior casing. The consistency of wood moisture contents at the top of the exterior casing is the result of the protection the roof overhang

affords to this part of the doorway. Moisture content at the top of the exterior casing was never above 30 percent, but in nine houses, either the exterior base of the jambs or the interior casing had moisture con-

tents above 30 percent (30 to 95 percent), a level beyond which decay occurs in untreated wood. In no case was a moisture content of above 30 percent caused by a specific rainfall. The fact that moisture content in the base of the frames varied considerably indicates that this area is often wet. Construction that retards drying has more influence on moisture content at the base than at the top of frames.

The moisture content of above 30 percent in some door frames could not be attributed to a particular construction detail. All frames with high moisture content had no caulking between the jamb and the exterior step, but so did many others. Some frames with high moisture content had weather stripping, others did not. Two door frames with high moisture contents were sheltered by roof overhangs extending more than 4 feet which suggests that even large overhangs may not protect frames from getting wet. In one doorway, a reverse grade on the exterior step caused water to accumulate against the threshold and door jamb, and it is possible that the situation occurred in other cases. Visible decay was found in the base of five frames and never in a door. Wood soft to a knife was found in 12 frames and in one door.

Houses usually faced one of the four cardinal directions, received little shelter from trees, and were built on nearly flat sites. No dangerously high moisture content was associated with doorway aspect and the difference in average moisture contents among frames facing different directions was very small. Still, statistical analysis indicated that direction affected moisture content of the exterior frame: $\alpha = .080$ for top of exterior casing and $\alpha = .110$ for base of exterior casing.

Doors

Thirty-three of the doorways had exterior, wood-panel screen doors; all of these doors were free of moisture-related defects. The moisture content at their bases averaged 12 percent (sd. = 3.33) which indicates that if the doors were wet by rains they apparently dried readily.

Thirty-two doors were of the panel type. All were free of moisture-related defects, and the moisture content at their bases averaged 12 percent (sd. = 1.91).

Thirty-seven of 189 flush doors (20 percent) had defects. Twenty-nine flush doors had veneer splitting at the base on the outside, and seven were discolored by fungi. Of the 189 flush doors, only one was sufficiently decayed that wood was soft to a knife probe. Defects were not associated with house age.

A statistical difference in moisture content existed for exterior base of door by direction faced ($\alpha = .001$). Average moisture contents for bases of doors was: north, 15 percent; south, 14 percent; east, 12 percent; and west, 13 percent. Veneer splitting was less frequent on north-facing doors than on doors

facing other directions; $\alpha = .05$ as computed by chi-square tests. Five of the 13 doors with splitting veneer (38 percent) occurred in a single development. These doors represented 56 percent of the houses that we examined in that development.

DISCUSSION

The fact that defects were most strongly related to developer suggests that doorways can be adequately constructed without greatly increasing the cost. Similar associations between developer and practices that affected performance of other wood products used in construction have been reported previously (DeGroot and Popham 1975).

Moisture associated failures in doors usually were physical failures (veneer splitting) rather than biological (fungal decay or insect attack). Frames, however, are exposed to decay. All but one instance of moisture content sufficient to support decay occurred in frames.

Observations of these houses suggest that three bands of exposure to prevailing rains can be delineated. The upper part of the doorway, which is as long as the roof overhang, is almost completely sheltered from rain. The middle band, which extends from lower margin of upper band to twice the length of overhang is subject to infrequent storm driven rains. The lower part of the wall is frequently wet by rain. This corresponds with Griffin's (1959) findings that a 36-inch overhang did not completely protect the entire wall from rain and a 24-inch overhang would not protect the average-height window sill or part of the lower sash unit from all rains.

Lateral absorption of water along the length of both frame and door is slight. Endgrained surfaces at the bases of both door and frame receive maximum exposure to rain, rain splash, and to water draining down the exterior surface. If water is not quickly drained off the threshold the interior casing can be wet. If these surfaces are not protected with a water repellent, rapid absorption and slow drying sustain high wood moisture content.

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